Concord Gas Company: Gasholder House
South Main Street
Concord
Merrimack County
New Hampshire

HAER No. NH-7

HAER
NH,
7-CON,
9C-

PHOTOGRAPHS
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WRITTEN HISTORICAL & DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
U.S. Department of the Interior
Washington, DC 20240

HISTORIC AMERICAN ENGINEERING RECORD

CONCORD GASHOLDER HOUSE
HAER No. NH-7

Location:	South Main Street, Concord, N.H., 0.2 miles south of intersection of South Main Street and U.S. Route 3. USGS 7.5 Minute Series-Concord, N.H. UTM Coordinates: Zone 19, Easting 2-94-340, Northing 47-85-455
Date of Construction:	1888
Engineers/Builders:	Deily & Fowler of Laurel Iron Works (Philadelphia), designer; W. C. Whyte (New York City), builder of tank and circular brick building; Laurel Iron Works, builder of gasholder.
Present Owner:	Concord Natural Gas Corp., Concord, N.H. 03301
Present Use:	Disused since 1952.
Significance:	The Concord Gasholder House, in service from 1888 to 1952, is the last structure of its kind in the United States still containing its original gasholder. Similar structures were a common feature in the urban areas of New England and upper New York. This one was built to increase the company's storage capacity and was retired when a natural gas pipeline reached Concord. This gasholder house and tank appear to be typical of those built in the late nineteenth century. The gasholder in this building is of the single lift type and is constructed of riveted iron plates. The holder has a capacity of 120,000 cubic feet.
Historian:	William L. Taylor, Professor of History, Plymouth State College, Plymouth, N.H. 03264

HISTORICAL REPORT FO CONCORD GASHOLDER HOUSE
WILLIAM L. TAYLOR, H. STORIAN*
APRIL 1984

During the last half of the eighteenth century, as scientific knowledge was increasing and the technology of industrialization spreading throughout Britain and parts of Western Europe, efforts to develop better and cheaper sources of illumination that would "extend the day" occupied the attention of many scientists and inventors. Success would have important consequences for the factories then in operation or under construction, since adequate lighting would enable greater utilization of the facilities. Because industrialization stimulated urbanization, it became evident that towns and cities, as well as factories, could become important customers for lighting systems. It is in this context that the search for ways to generate illuminating gas from coal and to distribute it through gas mains must be understood.

Perfection of the process of manufacturing gas from coal dates from the early years of the industrial revolution. Coal gas proved readily adaptable for lighting mills and urban areas where sufficient density existed to warrant investment in gas manufacturing and distribution systems.

First demonstrated in the United States in the late 1790s, its adoption as a lighting fuel was somewhat slow, compared to its adoption in England.[1] During the war years of 1812-1814 coal-gas illumination was used in cotton mills in New England. In 1816 the city of Baltimore passed an ordinance permitting the manufacture of gas and the laying of gas pipes under the streets. A newly

formed company signed a contract with the city for street lighting. This seems to have been the first operating gas company in the country. Boston had gas street lights in 1822[2]; other cities followed these examples so that within a decade or two gas manufacturing had become quite common throughout the urban areas of the nation. Mills that used gas for lighting frequently generated their own gas in these early years. By the 1830s gas lighting had been accepted as an improved form of lighting for industrial, commercial, and public locations. Technical problems such as satisfactory piping for distributing the gas and suitable lighting fixtures had been solved. Also of importance was the ability to sell gas at a price competitive with other lighting fuels. Illuminating gas did not, however, become widely used for domestic lighting until after the Civil War. Before that domestic usage seems to have been restricted primarily to wealthy households.[3]

The chartering of Concord Gas Light Company in 1850 started the process of bringing gaslights to the state's capital city. Not until August 1852 did the corporation hold its first meeting. At that time the company's capitalization totaled $35,000. Once its stock had been sold, the company used available funds to purchase land on the south side of the city from the Concord Railroad Company. Here Somersworth Machine Company constructed the original gasworks. The works were periodically enlarged as demand warranted.[4]

By 1870 the capitalization of the company had increased to $80,000. During the year ending June 1, 1870, the company manufactured 9,161,000 cubic feet of gas in 18 retorts using 1200 tons

of coal. The value of gas manufactured was $33,050. Operation of the gasworks required an average of six workers for the whole year.[5]

Ten years later the company had enlarged its capitalization to $100,000. The United States Census does not report on the manufacturing facilities, but does indicate that the value of gas produced for the year ending May 31, 1880, was $31,650. According to a company report issued in 1892, from the 1850s to the year of the report the price of gas had dropped from four mills/cubic foot to two mills/cubic foot. This, plus the twenty percent increase in capitalization between 1870 and 1880, suggest that each year more gas was manufactured.[6]

The ever rising demand for gas in Concord began to cause serious difficulties for the company in the late 1880s when, on days of heavy usage, the system would almost run out of gas because of the lack of adequate storage facilities. Two gasholders with capacities of 16,000 cubic feet each stood adjacent to the gashouse. Another was located at the end of the distribution line on the property of St. Paul's School and a fourth bordered the business district. The two holders out on the distribution system assisted in maintaining adequate pressure in the gas mains. These four gasholders had a capacity of 80,000 cubic feet, an amount that did not provide a sufficient reserve during days of heavy demand. The average daily output of the works was 95,000 cubic feet with the highest output being 112,000 cubic feet.[7]

The situation seems to have been common knowledge throughout the city as the Concord Evening Monitor noted in April 1888: "There were several occasions when at the hour of ten o'clock evening, the holders in town were entirely empty and the only gas used came back from the holder at St. Paul's School or was supplied by the constant make at the gasworks."[8] Had this happened earlier in the day, the city would have run out of gas.

The problem confronting the Concord Gas Light Company appears to have occurred elsewhere in the nation. The appearance of electricity as an alternative to gas lighting made gas companies take steps to retain a strong market for gas. Here was an example of competition making gas companies more innovative. They sought new uses for gas and they encouraged the improvement of gas ranges for cooking and promoted their use. Also promoted were gas engines. The invention of the Welsbach mantle in the mid-1880s helped gas maintain its position as a cheap lighting medium and enabled gas to compete more effectively with electricity.[9]

Whatever the specific reasons for the rise in consumption, the Concord company moved with dispatch to solve its storage problem as well as to meet projected future needs. In the summer of 1887 the company purchased a parcel of land from A. L. Woodman that abutted the northern boundary of the gasworks. On this parcel was to be constructed a new gasholder that would dwarf any then in use by the company. With its customers at times of heavy demand nearly depleting all reserves, the management decided to commence construction of the new holder in the spring of 1888 at an estimated cost of $30,000.[10]

Work on the new structure started on April 9, 1888, and was supposed to be completed by October. This construction schedule proved too optimistic, for the final inspection did not occur until December of that year. In addition, there was, as we would say today, a cost overrun of more than $5,000. Apparently the masonry work, connecting the holder to the mains, and grading and backfilling around the site were more costly than originally budgeted.[11]

Designed by Deily & Fowler of Laurel Iron Works, Philadelphia, the tank (see elevation on Sheet 2 of measured drawings) and circular brick building were built by W. C. Whyte of New York City. Laurel Iron Works assembled the holder. The local newspaper observed: "Construction parties are noted for their long experience and the excellence of their work. Mr. Whyte has built more than 50 tanks in various portions of the country and Messrs. Deily and Fowler [of Laurel Iron Works] holders running into the hundreds, which fact affords the best guarantee for the character of this structure."[12] Local contractors did some of the work including carpentry by E. B. Hutchinson, slating of the roof by W. M. Darrah, and brick manufactured by Samuel Holt.[13]

The new gasholder complex comprised three principal features: a masonry tank to hold the water for the water seal and within which the wrought-iron holder could rise and fall; the holder itself which held the gas and the weight of which provided pressure for the distribution of the gas; and the circular brick building encompassing the holder, which stood on top of the masonry tank. The new structure was typical of other enclosed gasholders

then being constructed in the northeastern United States.[14]

According to articles in the Concord Evening Monitor, the masonry tank was 82.5 feet in diameter and 24 feet deep. Filling the tank required 800,000 gallons of water. The bottom consisted of 12 inches of concrete made of cement, sand, and stone. The walls (whether brick or stone is not indicated) were laid entirely in cement. At the base the thickness was 34 inches tapering to 30 inches at the top. Wrought-iron bands were placed around the wall at two feet and seven feet below ground level. Each band had sixteen sections firmly locked together by wedges. The paper reported that this technique of banding was "an unusual method" adopted at the suggestion of John M. Hill "to secure the greatest possible strength."[15] Hill had altered the Deily & Fowler plans to suit the specific requirements of the Concord Gas Light Company.[16]

The new holder was of the single-lift type, 80 feet in diameter, and 24 feet high. Constructed of plates of boiler iron riveted together, it weighted 80,000 pounds. The holder was guided in its ascent and descent by guide rails (they appear to be railroad rails) and sheaves as shown in the plans.[17]

The handsome brick building that encloses the holder has changed little since its construction in 1888. The circular building is 86 feet in diameter and 28 feet high to the top of the wall. Building it required 550,000 brick "of the hardest kind" and 1400 casks of cement. The slate-shingle roof is conical with the apex 80 feet from the bottom of the tank. The main roof rafters of southern pine reach from the eaves to the apex. Two valve

houses (called "porches" in the newspaper articles) protrude from the circular structure. The gas came into the holder on the south side and exited at the valve house on the west where it entered the city distribution mains.[18]

The brick building protected the water in the tank from the cold weather and from problems associated with freezing. Any freezing of the water used as a seal would have impaired the rising and falling of the tank which maintained pressure in the distribution system and would have increased the danger of gas leaking from the holder. The gasholder house may also have permitted the use of thinner iron plates in the holder because it would keep snow off the top of the structure. Gasholder enclosures had cupolas to enable any gas leakage (lighter than air) to escape and disperse.[19]

Construction of the new complex required considerable landscaping and the building of a masonry retaining wall which is evident in the site plan and the documentary photographs. The 1888 holder sits at a significantly higher elevation than the rest of the gasworks. Since the holder is in a location not easily accessible from the rest of the company property, this may account for the fact that it has remained unaltered since 1952, when it was taken out of service.

With the completion of the new holder, Concord Gas Light Company had more than adequate storage capacity. During the inspection it was described as "one of the very best [holders] . . . solid, substantial, and embodying all the modern ideas and appliances."[20] Passing inspection meant that the holder could be

placed in service, and not a moment too soon. At the annual meeting of the company on September 5, 1888, the management reported sales of 20,921,000 cubic feet for the year ending June 30, a fifteen percent increase over the 18,290,000 feet sold in 1887. To produce this the works consumed 2242 tons of coal in 1887-1888 compared to 2011 the year before. These figures emphasize how the plant had to increase its storage, for that pre-1888 plant was selling only 9,161,000 cubic feet in 1869-1870. The new holder seems to have provided adequate reserve storage since another, and still larger, holder would not be built until 1921.[21]

With the new holder in service, changes could be made in the gasworks. The 16,000-cubic-foot gasholder nearest the retort house, which appears on the 1879 Sanborn Fire Insurance Map, does not appear on the 1889 edition of the Sanborn map. On the latter a circular storehouse is shown on Gas Street. Obviously, the company took the old holder out of service, but the map shows that the wooden building enclosing the holder was moved to a site on Gas Street, approximately 75 feet from where it originally stood, to become a storehouse.[22] The remaining 16,000-cubic-foot holder likely served as the first repository of manufactured gas before it went to the 1888 holder. This was standard operating procedure so as to allow the heavier tars and residue to settle out of the raw gas before purification.

During the late 1880s the company sought to meet the challenge posed by a new lighting and power technology--electricity. In 1887 Concord Gas Light had its charter altered to enable it to furnish

light and power by electricity. Two years later the company purchased the electric generating plant owned by Concord Electric Company. According to the Annual Report of 1892, this was done "in response to popular request." Apparently this diversification did not eliminate competition, for the city of Concord signed a contract for street lighting with Concord Land and Water Power Company. Given its bias toward gas, Concord Gas Light denigrated the investment potential in electric power generation. Whether this as an acerbic comment because it lost the street lighting contract or for some other reason is today unclear. One suspects, however, the success of its competitor did not set well in Concord Gas Light executive offices.[23]

Other changes were occurring also. In October 1892 Concord Gas Light signed a contract with United Gas Improvement Company of Philadelphia. The contract provided for United Gas to run Concord Gas Light for fifty years commencing January 1, 1893. At that time the Concord system totaled 19 1/3 miles of pipe ranging in size from 12-inch mains to 3/4-inch branch distribution lines. No change took place in the company name or in operations at the local level, but United Gas, a large holding company, did control policy and designed new facilities for the Concord works.[24]

Almost immediately modernization of the gasworks began. Plans, dated 1893, for a twelve-sided oil house survive in the Concord Natural Gas Corp. files, giving evidence of the conversion of the gas-making process from the traditional burning of coal in retorts to the carbureted water gas process.

In the retort process, coal is heated to very high temperatures inside a retort made of iron. When coal is subjected to intense heat in a closed vessel, certain gases and vapors are driven off. Some of these are combustible, and, like steam, condensable. Remaining behind is a residue of coke. The process just outlined is termed destructive distillation, a process almost universally employed in the early years of the production of illuminating gas. Before sending the gas into the mains for distribution to consumers, the condensable vapors like tar and water along with other chemical impurities like carbonic acid, sulphuretted hydrogen, and ammonia had to be removed. Accomplishing this required special tar removers, washers, and the like. Many gas companies sold these by-products as well as the coke remaining after distillation.

In the 1870s inventors, one in France and one in the United States, developed independently methods of manufacturing "water gas." The new process involved the chemical decomposition of steam by passing it over incandescent coke or coal, resulting in a mixture of hydrogen and carbon monoxide. Both are flammable gases, but burn without any illuminating qualities. To enhance the candlepower of the gas, vaporized oil is introduced into the hydrogen-carbon monoxide mixture in a process termed "carbureted water gas," thereby raising the candlepower of the gas to satisfactory levels. After 1880 the water-gas process spread rapidly and supplanted the old process in many localities. One of these was Concord.[25]

United Gas Improvement plans for the twelve-sided oil storage house indicate that the conversion from coal gas-making in retorts

to the manufacture of carbureted water gas occurred about 1893 or 1894. The apparatus consisted of (1) a generator in which incandescent coke or coal began the decomposition of the steam passing through it creating carbon monoxide and hydrogen; (2) the carburetor where the oil was introduced; (3) a superheater (at 1300-1400° F) to mix the chemical compounds in the proper proportion; (4) a water seal to prevent any gas from leaking back into the superheater; (5) a wash box to remove most of the tar and other impurities; and (6) a condenser to cool the gas (to 80-100° F) before it went into the first gasholder, called the relief holder. Prior to being sent out into the distribution system, however, the raw or "sour" gas was sent into the purifier house to remove the sulphur. To accomplish this exhausters pulled gas from the relief holder into the purifier house where the raw gas passed through a series of large closed boxes containing cedar wood shavings coated with iron oxide. The shavings kept the powdered iron oxide porous so that the gas would be brought into intimate contact with the oxide. As the gas passed through the boxes, the hydrogen sulfide in the gas united chemically with the oxide producing iron sulfide. The now purified gas went into the second gasholder, known as the storage holder, for distribution. The 1888 gasholder was used as the storage holder until the early 1920s.[26]

The carbureted-water-gas process installed by United Gas Improvement was to be the process used in Concord until 1952 when gas making ceased. Installing the new equipment required considerable alteration of the site. The company constructed a generator house

at the south end of the retort house which contained two sets of water-gas apparatus. Already mentioned, a twelve-sided oil-storage house was built a short distance west of the generator building.[27]

No other major change occurred at Concord Light and Power (its new name) until after World War I. In 1921 Concord Gas Company (still another name change) commenced construction of a steel telescoping gasholder with a capacity of 500,000 cubic feet. Once more the company needed additional storage capacity as the city grew in size and more and more customers shifted to gas for cooking and some space and water heating. By this date gas as an illuminant had ceased to be a significant market. This fact is confirmed by the change in name of the corporation to Concord Gas Company.

Completion of the telescoping holder altered the use of the 1888 holder. Whereas originally it had served as the storage holder for distribution into the gas mains, after the new holder entered service, the old holder served as the relief holder for raw gas from the gas house. From it the exhausters drew the gas for purification into the purifier house. The purified gas was then pumped into the new steel holder, now the storage holder, ready for distribution into the system. While the gas was in the 1888 holder, remaining tar would precipitate out. As noted earlier, before 1921 this process likely was accomplished in the one surviving 16,000-cubic-foot holder.[28] With the steel holder in service, the small holder no longer was needed and was dismantled. Precisely when the company did this is uncertain, but it does not appear on a 1932 site plan of the gasworks. No changes of consequence were made at the

works from the early 1920s until 1952 when gas manufacturing ceased.

The Concord gasworks in 1909 was one of fourteen gas-manufacturing establishsments in New Hampshire. They employed 250 men to operate the works and service the distribution systems and customer problems. These fourteen companies produced gas worth $581,000. As would be expected, they produced gas only for the more densely populated areas and were found in all of the large urban centers. No easily accessible statistics are available on how much gas each produced or the type of manufacturing process each company used.[29]

The plant in Concord continued the manufacture of carbureted water gas until 1952 when the natural gas pipeline reached the city. The company in the thirty-one years since the construction of its second major gasholder had seen the local demand for gas increase to the point that, during the late 1940s and early 1950s, the generator set in use had to be driven far beyond its designed capacity in order to make enough gas to meet the demand. Each set was designed to generate 500,000 cubic feet per day. In the last winter of operation (1952-1952) Cedric H. Dustin, Jr., now president of the company, stated that a record, 1,359,000 cubic feet was produced during a twenty-four hour period. The ability to exceed designed capacity by such a large amount was possible because of the use of better coal and high grade oil. The gas produced in the last few years of operation had a heating value of 525 BTU/cubic foot (the state-mandated minimum heat value). A major factor in the rising demand for gas was the increase in space heating, for by 1951-1952 approximately one hundred customers heated with gas.

By this date the distribution system totaled forty-five miles.[30]

Gas making at the Concord Gas Company works appears to have been little changed by new technology and/or automatic devices, although the controls were, near the end of the manufacturing era, driven hydraulically. Charging the generator with coal was still done by hand as was the removal of ashes. The process described by Cedric Dustin differed little from that outlined in a book on gasworks operation that was published in 1917.[31]

The Concord works required continuous operation with three eight-hour shifts in winter and two eight-hour shifts in summer. During the summer the 11:00 P.M.-7:00 A.M. shift rarely made gas. The crew of each shift comprised a gasmaker and two helpers. In the last years of gas making most of the personnel at the works were of Italaan descent. The skills required of the gasmaker were carefully guarded by these individuals. They did not share freely their knowledge. In summer the helpers unloaded coal from the railroad cars on the adjacent siding, whereas in winter, when gas making had to be virtually continuous, the street crews did this chore. Since regular work on the distribution lines was normally suspended in cold weather, these men were available for other tasks.

During the winter months, when demand for gas was highest, the pace of activity in the gashouse bordered on the frantic. Ashes had to be removed twice a day (only once in summer). Because the generator had to be recharged with coal as rapidly as possible to reduce down time, ashes and clinkers were pulled out on the floor and the generator recharged with coal on the charging floor above.

The crew would clean up and remove the hot, smoking ashes, as time permitted, later in the shift. This process of removing ashes, cleaning the fire and removing clinkers, and then recharging with coal took about twenty minutes. During summer it was done about 1:00 P.M., taking about an hour, as demand slackened after lunch time.[32]

The design of the gasworks consciously incorporated redundancy in the generating equipment so that one set could be repaired while the other (or others in the case of larger works) carried on gas manufacturing. At Concord one generator set operated six or seven months, then the other took over for five or six months. The company sought to balance usage over a period of years. While out of service, crews rebuilt the generator, carburetor, and superheater. The intricate brick work, fire box, and the like had to be checked and reconstructed as necessary. Such work was normally scheduled in winter because the street crews were available to assist. The same redundancy existed in the steam boilers. Only one of the two boilers operated to supply steam for gasmaking as well as to power the blowers that drove air through the fire to heat the generator, carburetor, and superheater. Repairs to the out-of-service boiler were scheduled as required to insure continuous operation when placed in service.[33]

All of this came to an abrupt end in the summer of 1952 when the company joined the expanding network of natural gas pipelines that brought gas from the southwestern gas fields. Reflecting the change in fuel distributed by the company, Concord Gas Company

changed its name to Concord Natural Gas Corporation. On August 7, 1952, a full page advertisement appeared in the Concord newspaper informing customers of the change and how it would proceed. Conversion commenced Autust 13, with the city divided into six sections. Gas company crews had to replace orifices in all gas appliances for compatibility with natural gas (of higher BTU value than water gas). All the work was scheduled to be completed by the end of August.[34]

As each section of the city switched from manufactured gas to natural gas, the gasworks reduced its output accordingly and began to reduced the amount of gas stored in the holders. On the final day of gas making the holders were virtually empty of manufactured gas.[35]

From late summer 1952 to the present the 1888 holder has been out of service. The 1921 holder remains in use as a reserve of natural gas for the city should an interruption occur in the supply by pipeline.

Although out of service for over thrity years, the 1888 holder has not been altered or converted to another use. As far as can be determined, it is the only surviving gasholder house with its gasholder intact anywhere in the United States. Its location on the berm above the rest of the property and the lack of easy access from heavily used South Main Street have made it rather difficult for the company to convert it to another use. How long the holder and the building will remain in their current state is unknown. According to management, no changes are anticipated in the

immediate future.

The Concord gasholder exemplifies an industrial artifact once common in an earlier era and denotes a technology found in urban areas throughout the nation. The gasholder house indicates how nineteenth-century companies sought to make their facilities aesthetically pleasing to the eye and an asset to the locale. This building and many of the other surviving structures of the manufactured-gas era convey the effort of management to demonstrate a pride in industrial facilities by devoting attention to architectural details.

The 1921 gasholder connotes a shift to what has become more characteristic of twentieth-century industrial structures. It is strictly functional. Its designer made no pretense of trying to make it compatible with the surrounding environment.

An unaltered gasholder from the nineteenth century, still surviving after decades of disuse, is one of those fortunate circumstances for which industrial archeologists must be appreciative. This quite ordinary structure has become a unique artifact and an example of a once quite important, but not very spectacular, manufacturing process. It and those now vanished aided immeasurably in improving the quality of life in the nineteenth and twentieth centuries.

*The author wishes to thank Quentin Blaine for his excellent historical research. Much of that research was essential for this report.

[1]Leander J. Bishop, A History of American Manufactures from 1608 to 1860 (3rd edition, 3 vols., New York: Augustus M. Kelley, 1966 [reprint of 1868 edition]), 2: 93.

[2]Ibid., 2: 231; The Story of Gas: A Brief Sketch of the Manufactured and Natural Gas Industry (New York: American Gas Association, n.d. [c1950]), 7. Victor Clark implies that Boston was the first to use gaslights for street lighting. See Victor S. Clark, History of Manufactures in the United States (3 vols., New York: Peter Smith, 1949 [reprint of 1929 edition]), 1: 494.

[3]Story of Gas, 8.

[4]Concord Gas Light Co., Annual Report, 1892, 3-6. John Murray lists charter date as 1853 in American Gas-Light Journal, June 15, 1863.

[5]U.S. Census Office, New Hampshire Census, Seventh Census, 1870, Manufactures, Vol. 26, Concord. Manuscript volume in New Hampshire State Library, Concord.

[6]Concord Gas Light Co., Annual Report, 1892, 6-7.

[7]Concord Evening Monitor, April 7, 1888.

[8]Ibid.

[9]Clark, History of Manufactures, 2: 516.

[10]Concord Evening Monitor, April 7 and December 4, 1888.

[11]Ibid.

[12]Ibid., April 7, 1888.

[13]Ibid.

[14]See measured drawings and photographs. In April 1872 the New York Times described the appearance and operation of these types of holders. "To the untutored eye they present the appearance, when fully distended, of circular castles or forts, without portholes, embrasures or sally ports, or to the less military mind they might suggest selections of two enormous boilers, one sliding within the other, and set vertically into the ground. This ground tank contains sufficient water to prevent the gas from escaping under the edge of the holder. When exhausted, the sections slide one within the other, like a telescope when shut up, and the whole affair sits

down in the tank so that the top is nearly on a level with the surface of the ground. As the gas is let in and the pressure increases, the huge iron cylinders rise up and the inner one slides up until the holder is fully extended. These are called telescopic holders. Some are made with only a single section, or 'single lift' as it is called. The average dimensions of the holders approximate seventy feet in diameter with height of about 60 feet, and a capacity of less than 850,000 [cubic] feet." New York Times, April 7, 1872, as cited in Diana S. Waite, "Gasholder House 1873: Try Gas Light Company, Troy [N.Y.]," in Robert M. Vogel, ed., A Report on the Mohawk-Hudson Area Survey (Smithsonian Studies in History and Technology, No. 26, Washington: Smithsonian Institution Press, 1973), 47.

[15]Concord Evening Monitor, April 7 and December 4, 1888.

[16]Ibid., April 7, 1888.

[17]Ibid., December 7, 1888.

[18]Ibid., April 7 and December 4, 1888.

[19]See Waite, "Gasholder House 1873," 44-46; Theodore A. Sande, Industrial Archeology: A New Look at the American Heritage (Brattleboro, Vt.: Stephen Greene Press, 1976), 58-59.

[20]Concord Evening Monitor, December 4, 1888.

[21]For production totals in 1869-1870 see Seventh Census, 1870, Manufactures, Vol. 26, Concord.

[22]See Sanborn Fire Insurance Maps of Concord for 1879, 1889. See United Gas improvement Co. plan dated 1905 in New Hampshire Historical Society, Concord, N.H.

[23]Concord Gas Light Co., Annual Report, 1892, 7-10.

[24]Contract in New Hampshire Historical Society, file of Concord Gas Light Co.

[25]See Clark, History of Manufactures, 2: 516.

[26]Information for this process compiled from Walter M. Russell, Operation of Gas Works (New York: McGraw-Hill Book Co., 1917), 111-141; interview with Cedric H. Dustin, Jr., President of Concord Natural Gas Corp., January 26, 1983, in Concord, N.H.; "Processes for Manufacturing Gas," American Gas Journal (February 1951), 29-30. See also Denys Peter Myers, Gaslighting in America: A Guide for Historic Preservation (Washington: Heritage Conservation and Recreation Service, U.S. Department of the Interior, Government Printing Office, 1978).

[27]To understand how the changes altered the property see Sanborn Fire Insurance Maps of Concord for 1889 and 1899. See also plan of oil house in files of Concord Natural Gas Corp., Concord, N.H.

[28]Dustin interview; Story of Gas, 16.

[29]U.S. Bureau of the Census, Thirteenth Census of the United States: Abstract of the Census with Supplement for New Hampshire (Washington: Government Printing Office, 1913), 614, 618.

[30]Dustin interview.

[31]Ibid. See also Russell, Operation of Gas Works.

[32]Information for the operation of the Concord gasworks came from Dustin interview.

[33]Ibid.

[34]Concord Daily Monitor and New Hampshire Patriot, August 7 and 12, 1952.

[35]Dustin interview.

TABLE I

CAPITALIZATION OF CONCORD GAS LIGHT CO.

Year	Capitalization
1853	$ 35,000
1854	45,000
1859	50,000
1866	60,000
1868	70,000
1870	80,000
1873	90,000
1874	100,000
1889	125,000
1891	150,000

Source: Concord Gas Light Co., Annual Report, 1892, 6.

TABLE II

PRICE OF GAS IN CONCORD, 1853-1886

Year	Price in Mills
1854	4
1859	3.5
1864	4
1868	3.6
1876	3
1884	2.2
1886	2

Note: 2 mills = $2.00/cubic foot in 1886. Price for customers using over 100,000 cubic feet/year was 1.8 mills.
Source: Ibid., 6-7.

TABLE III

U.S. GASHOLDER HOUSE INVENTORY*

Location	Date	Material	Present Use	Notes
Attleboro Falls, Mass.	?	Brick	Storage	1
Batavia, N.Y.	?	Brick	Utility company storage	2
Batavia, N.Y.	?	Brick	"	2
Biddeford, Me.	1891	Brick	Disused (utility company)	
(South) Boston, Mass.	?	Brick	Storage (?)	1
Concord, N.H.	?	Brick	St. Paul's School post office	
Concord, N.H.	1888	Brick	Houses disused holder	
Concord, N.H.	?	Brick	Unknown	4
Northampton, Mass.	?	Brick	Disused	5
Pittsfield, Mass.	?	Brick	Unknown	
Saratoga, N.Y.	?	Brick	Utility company storage	1
Troy, N.Y.	1873	Brick	Painting contractor's garage & warehouse	
Valley Falls, R.I.	?	Brick	Utility company storage	1
Warren, R.I.	?	Brick	"	1
Woonsocket, R.I.	?	Brick	Cabinetmaker's shop	3

Notes: *List adapted from one compiled by Robert Vogel, National Museum of American History, Smithsonian Institution, c1981. No verification was attempted on any items listed. Reference to a wooden gasholder house in Concord was deleted because this was almost certainly the 12-sided oil house.

TABLE III (continued)

[1]Not seen in recent years--information not current.

[2]The two houses medium sized and identical.

[3]Polygonal in plan. Most gasholder houses were circular with pilasters at the supports.

[4]On the grounds of the N.H. State Hospital.

[5]Was for sale to developer in spring 1977. May have been demolished.